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NEMERTEA

BY

J. F. G. WHEELER, D.Sc., F.L.S.

(Bermuda Biological Station for Research)

WITH TWO TEXT-FIGURES

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INTRODUCTION.

The Nemerteans collected by the Expedition were two specimens of a littoral form taken with a dredge in shallow water off the Arabian coast, and a single specimen of a pelagic form sorted from the plankton taken in the Indian Ocean. The former proved to be *Amphiporus reticulatus*, Bürger, previously recorded only from the Gulf of Naples; the latter an unknown species described in this report under the name *Nannonemertes indica*.

Order HOPLONEMERTINI, Hubrecht, 1879.

Sub-Order MONOSTYLIFERA, Brinkmann, 1917.

Amphiporus reticulatus, Bürger, 1895.

Two specimens of a small Nemertean (Ne4) were taken at Station 53 on November 2nd, 1933, in 13½ metres, with a triangular dredge. Neither sketch nor note of colour or markings was made. One specimen was sectioned at 10μ (Ne4b), and the anatomical details given below are from this series; the other (Ne4a) was cleared in cedarwood oil, and its identity with Ne4b established from the number and arrangement of the eyespots and the armature.

Both specimens were of the bleached appearance common to almost all preserved Nemerteans, without markings, somewhat flattened, 16–18 mm. long and 1·2–1·5 mm. in width. The specimen sectioned, which was the larger, showed signs of a definite head, marked off from the body by a shallow constriction. In the other specimen the head end could be determined only by clearing, but in both worms the tail was more acutely pointed than the head (Text-fig. 1, A and B). The surface of the bodies showed fine annular wrinkles. When cleared, the eyespots could be seen as brown cup-shaped bodies, eight or ten on each side, while from above the arrangement appeared irregular (Text-fig. 1, C and D). In specimen Ne4a there was a dorsal groove at the head which turned forwards

laterally to the tip of the snout and into which, in the sectioned specimen, the canals of the cerebral organs were found to open.

The epithelium is not very thick, but it is thicker dorsally than ventrally and is thinner at the sides of the body than elsewhere. This holds especially for the anterior sections (Text-fig. 1, E). Posteriorly there is little difference (Text-fig. 1, F). The basement layer is considerably thicker than the circular muscle sheet, and is more conspicuous at the hinder end of the body, where the epithelium is thin. The longitudinal muscles are well developed (Text-fig. 1, E and F).

The mouth opens into the rhynchodæum at the tip of the head, and the narrow œsophagus becomes a capacious stomach between and behind the ganglia. The anterior cæcum branches, the branches extending forward and just overlapping the ends of the cerebral organs (Text-fig. 1, E). There is a head gland, opening dorsally to the rhynchodæum and forming a compact investment to its dorsal muscles. It passes inside the vascular loop and reaches the brain.

The rhynchocœl extends almost to the tip of the tail. The proboscis is stout (Text-fig. 1, C and E), has ten nerve strands, and is armed with the usual main stylet and two accessory reservoirs of stylets. In specimen Ne4a the main stylet, base and accessory stylets could be seen and measured on clearing. In Ne4b the main stylet was broken on sectioning, but the length of the base could be estimated from the sections and the accessories were still present. The main stylet and accessory stylets (in Ne4a) were of the same length, 0·08 mm., and the base was small, 0·045 mm. There were six accessories in each reservoir. In Ne4b the accessories were five and six; they were smaller than those of Ne4a, and the base of the main stylet did not appear on more than two consecutive sections, which suggests that its length was not much greater than 20μ, although it had been cut obliquely. The vascular system could not be clearly traced, except the lateral vessels close to the lateral nerves, and a dorsal vessel above the gut, outside the musculature of the rhynchocœl. There is, however, a vascular loop in the head in front of the brain.

On one side a single excretory duct was seen leading to the exterior below the lateral nerve close behind the cerebral organ (Text-fig. 1, E).

The brain is large, with a stout ventral and a thin dorsal commissure. The ventral lobes are considerably smaller than the dorsal and pass into the lateral cords under them. The sections showed a twist of the lateral nerves on leaving the brain that was probably due to strong contraction of the body on fixation. The cerebral organs are large. The canals open laterally near the tip of the snout and pass back along the sides of the dorsal ganglia. As the organs expand they become wedged beneath the ganglia and overlap them posteriorly. They are connected with the ganglia at the hinder ends of the latter (Text-fig. 1, E).

Ne4a was a female, with eggs ripening and almost filling the body for the greater part of its length. Ne4b was a male, also with ripening gonads extending down the body. The gonads develop above and below the gut branches.

The omission of any observation on the colour or marking of these worms in life introduces an element of doubt into their specific identification. They belong to the genus *Amphiporus*, and have distinctive characters in the possession of a head gland and a base to the main stylet smaller than the stylet itself. These characters dispose of an identification with *A. pulcher* (Johnst.) or *A. lactifloreus* (Johnst.)—a possibility suggested by the dubious position of *A. albicans*, Ehrenberg, captured in the Red Sea. McIntosh (1873)

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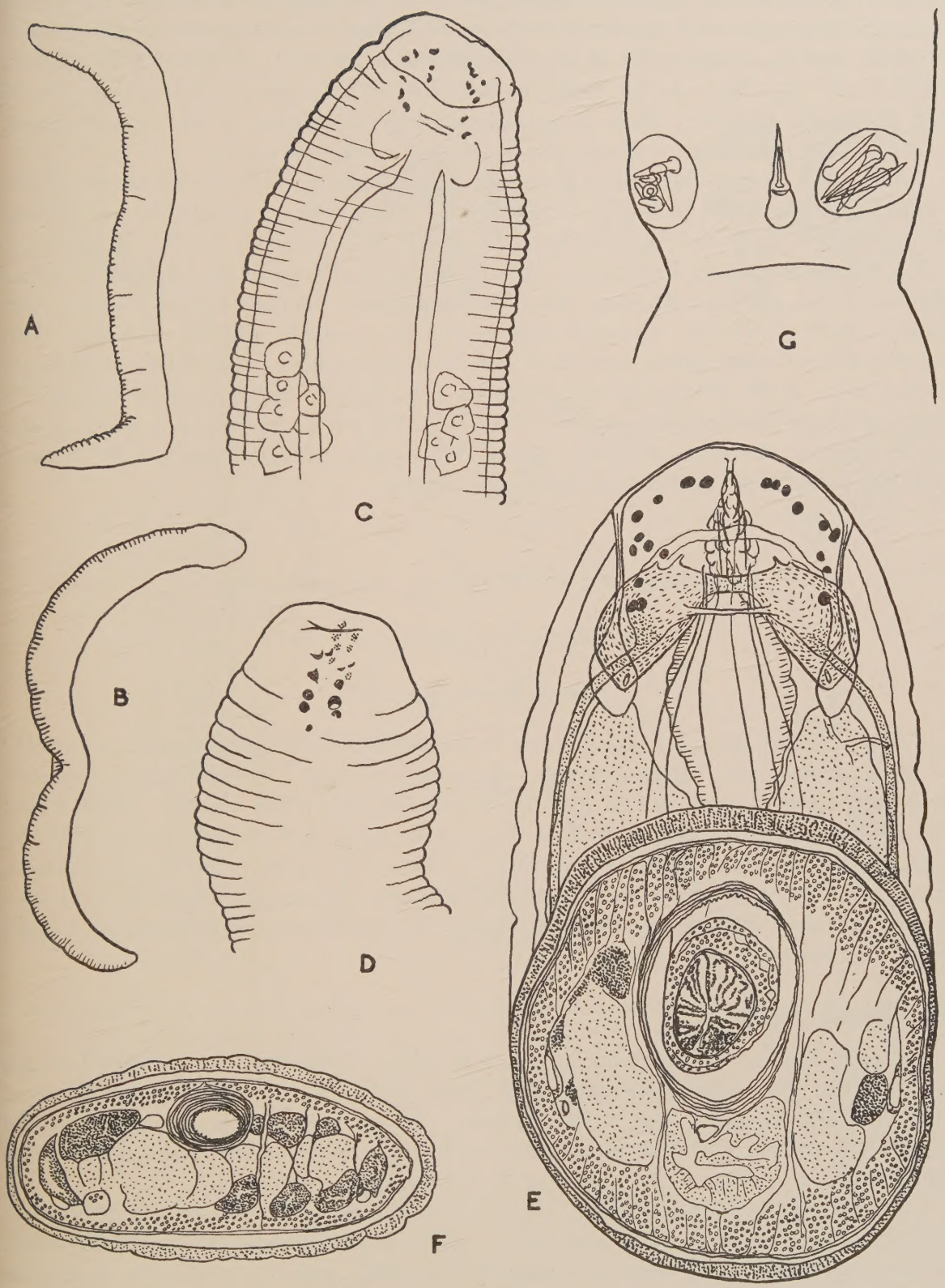


TEXT-FIG. 1.—*Amphiporus reticulatus*, Bürger. A and B, Outline drawings of the two specimens. C and D, Sketches of the heads to show the eyespots. E, Graphical reconstruction of the head of B. F, Transverse section of B, close to the posterior end of the body. G, Armature of A.

wrote: " For some time I was inclined to include the *Amphiporus albicans* of Ehrenberg under the synonyms, as it has many characters in common, but it approaches *A. pulcher* in others, and the arrangement of the eye-specks in his figure is so different that I have struck it off " (p. 158). Joubin (1894) identified it with *A. roseus* (O.F.M.), synonymous with *A. pulcher* (Johnst.), while Bürger admitted the possibility of this identity (1895, p. 13), but later (1904) gave *A. albicans* the rank of a separate species.

As far as it goes the description given above agrees with that of *Amphiporus reticulatus*, Bürger, from the Gulf of Naples: " Kopfende nicht verjüngt, abgerundet, Kopf vom Rumpf deutlich abgesetzt. Rücken braunrot, Bauch hellbraun oder rötlich; Kopffurchen gelb. Mit starker kurzer Kopfdrüse. Mit 16–28 Augen, die jederseits im Kopf 2 Reihen bilden; je ein grösseres flacheres Auge ist unmittelbar vor dem Gehirn gelegen. Der Rüssel enthält 10 Nerven. Dorsale Ganglien doppelt so mächtig wie den ventralen. Das ziemlich kleine Cerebralorgan liegt hinter den dorsalen Ganglien. Stilett ein wenig länger als der dicke, in der Mitte ringförmig eingeschnürte Sockel. Mit 2 Reservestilettaschen, deren jede 4–10 Reservestilette enthält. L. 30–50, Br. 1·5–2 mm." (Bürger, 1904, p. 41). In the absence, therefore, of colour notes, which might have put the identity beyond question, I refer these worms to *A. reticulatus*, Bürger.

Sub-Order POLYSTYLIFERA, Brinkmann, 1917.

Tribe PELAGICA, Brinkmann, 1917.

Nannonemertes, gen. nov.

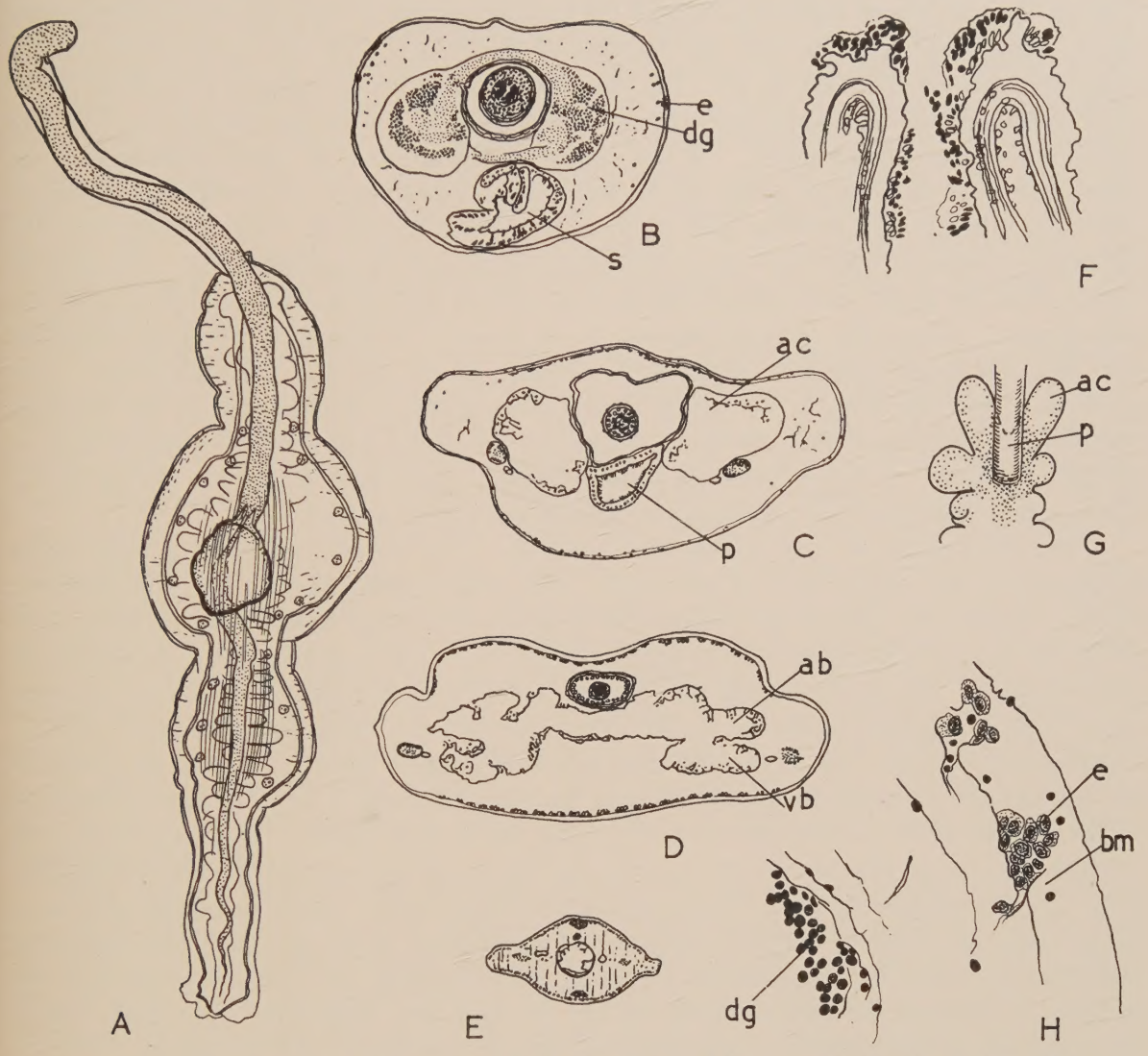
Body hyaline, thin, lanceolate, oval in section anteriorly and flattened posteriorly to a truncated tail. Body muscles extremely reduced. Proboscis-pore terminal. Proboscis relatively stout and at least as long as the body when everted. Rhynchocœl extends throughout the body. Wall of the rhynchocœl formed of inner longitudinal and outer circular muscles. Mouth subterminal, in front of the brain. Gut-branches simple, twenty to twenty-five on each side, the anterior branches with ventral branchlets. Anterior cæcum reduced. Median unpaired sac absent. No lateral nerve muscle-strands. Brain large. Rudimentary eyes present.

Nannonemertes indica, n. sp.

One specimen, an immature female, was taken at Station 131, midway between Zanzibar and Colombo, on February 11th, 1934, with a 1-metre stramin net fished at 1500 metres and hauled open to the surface. It was preserved in formalin with the plankton from the haul and sorted later. No note of the colour was made. After examination it was cleared in cedarwood oil and sectioned completely.

The body is almost transparent, colourless and flattened, 4 mm. long, 1 mm. broad at the broadest part, and about 0·5 mm. thick. In front of the middle the lanceolate outline of the body as seen from above is broken by a swelling, which on clearing is seen to be accompanied by, and probably due to, a dilated region of the rhynchocœl. At the posterior end the edges of the body appear to be flattened somewhat to form the tail. A longitudinal muscle sheet is visible dorsally and ventrally, as a narrow band confined to the middle

region of the body and not extending far laterally. Blunt branches of the gut and the ganglia and lateral nerves can just be seen. The nerves pass down the body laterally to the gut branches. The proboscis is stout (Text-fig. 2, A). Clearing in cedarwood oil showed



TEXT-FIG. 2.—*Nannonemertes indica*, n. sp. A, Outline sketch of the animal before clearing (gonads added to the sketch after clearing). B, Transverse section of the brain region. C, Section showing the pylorus and anterior cæcum. D, Section of the body behind the enlargement. F, Longitudinal section of the tip of the proboscis. G, Diagram showing the pylorus, anterior cæcum and gut. H, Part of a section in the brain region to show the rudimentary eyes. *a.c.*, anterior cæcum; *b.m.*, basement layer; *d.b.*, dorsal branch of gut; *d.g.*, dorsal ganglion; *e.*, rudimentary eye; *p.*, pylorus; *s.*, stomach; *v.b.*, ventral branch of gut.

that the proboscis was fixed with the armature between the ganglia, indicating that the fully everted proboscis would be at least as long as the body. The rhynchocœl reaches almost to the tip of the tail. The dorsal ganglia appear considerably denser than the ventral, and nine small genital sacs can be seen on each side of the body just within the lateral nerves. These are shown in Text-fig. 2, A, although they were not observed before clearing.

There is no epithelium. The basement layer is thin except laterally at the head. In section at the region of the brain there is no visible body musculature, although fibres can be traced in the parenchyma (Text-fig. 2, B). In the mid-body the longitudinal sheets can be seen (Text-fig. 2, C and D), but they do not extend to the sides of the body, and it is only in the tail, where there is a median dorsal and ventral thickening of the longitudinal layer, which here extends into the margins of the body, that the musculature attains some prominence (Text-fig. 2, E). The circular muscle-layer is reduced to isolated fibres. The unstained and featureless parenchyma is very evident, for the gut-branches are neither numerous nor much branched. In the proboscis the number of nerve-strands and the arrangement of the muscles could not be determined, but there is a structureless basement layer ensheathing the muscles and of about the same thickness. The retractor of the proboscis is inserted into the wall of the rhynchocœl near its posterior end. No muscle-layers could be made out in transverse sections of the wall of the rhynchocœl, but at the enlargement, where the sections happen to be frontal, longitudinal fibres predominate and form an inner layer with a sparse investment of circular and diagonal fibres. The position of the armature in the partly extended proboscis was confirmed in the sections, but the armature itself was not seen. There are no lateral nerve muscle-strands such as Bürger described in *Balœnanemertes chuni* (Bürger, 1909), and which are found in the Pelagonemertidæ generally according to Brinkmann (1917, p. 109).

The proboscis-pore and mouth are separate. The former is terminal, the latter subterminal, and just in front of the brain. The mouth opens directly into the stomach, which is lined with ciliated epithelium and possesses numerous deeply-staining gland-cells (Text-fig. 2, B). Further back, in the pyloric region, there are no gland-cells, and the cilia are more evident. The pylorus opens into the gut, which is at this point a capacious chamber, since there is a lateral expansion on each side. Anteriorly, immediately in front of these expansions, two branches of the gut pass forward (anterior cæcum), one on each side of the pylorus and rhynchocœl, and end behind the brain (Text-fig. 2, G). The lateral branches of the gut are blunt pockets which do not reach the lateral nerves. There are twenty to twenty-five on each side, the anterior pockets having dorsal and ventral branchlets (Text-fig. 2, D), the former passing above the gonads where these occur. Some shrinkage may have taken place on fixation, causing swelling and shortening of the gut-branches similar to that demonstrated in *Pelagonemertes* (Wheeler, 1934, p. 286), but I do not think that the pockets overlapped the lateral nerves in life, or that they were much branched. Since the specimen is not mature it is possible that the gut is not yet fully developed.

Lateral vessels have been traced near the lateral nerves, joining behind the brain into a transverse sinus and meeting posteriorly over the end of the gut just in front of the anus. A dorsal vessel has been observed for a short distance along the wall of the rhynchocœl, but neither its origin nor its destination could be seen.

The brain is large (Text-fig. 2, A and B) and shows considerable preponderance of dorsal fibres and nerve-cells over the ventral fibres. Part of the dorsal fibres continue into the lateral nerves to form an ill-defined strand, but I have not been able to trace this far down the body, and I have found no transverse connections between the lateral nerves. The lateral nerves run close to the margins of the body, but are not in contact with the muscles of the body wall.

In the brain region only I have found small patches of nucleated cells beneath the basement membrane (Text-fig. 2, H). There are six or eight on each side, and they appear to

correspond with the organs designated " rudimentary eyes " by Bürger, who discovered them in *Pelagonemertes*. Nine genital sacs, containing immature ova, are present on each side close to the lateral nerves and ventrally to the branches of the gut.

Systematic position.—This animal exhibits a combination of characters diagnostic of different families and cannot be identified with any known species. Chief among these characters are the thin lanceolate outline of the body, with the tail formed partly by flattening and partly by outgrowth ; the extent of the rhynchocœl, and the length of the proboscis ; the size of the brain and the presence of the patches of cells at the head, similar to those described by Bürger as rudimentary eyes ; the extreme reduction of the muscles of the body-wall ; the absence of longitudinal muscle-strands passing down the body with the lateral nerves ; the single branch of the anterior caecum without an unpaired median sac ; the small number of gut-branches and their simple form, with the correspondingly great development of the body-parenchyma, to which is apparently due such rigidity as the body possesses.

The specimen is immature, and doubtless some changes in proportion can be expected with increasing age. Bürger suggests (1909, p. 191) that the number of gut-branches in *Pelagonemertes rollestoni* may vary with the age of the individual. I found, however (1934, p. 286), that the smallest *P. rollestoni* (13·0 cm.) from the South Atlantic possessed sixteen branches on each side, while the largest (35·0 cm.) had fourteen and fifteen. Such differences are probably due to individual variation. There certainly was variation in the proportion of length to breadth among these specimens of *Pelagonemertes*, but the variations showed no progression, which again suggests that such variations are individual and constant through life. The branches of the gut may grow larger with age and perhaps increase in complexity by the formation of branchlets, so that the parenchyma becomes less evident ; and it is probable that, with increase in size of the body, the brain and musculature would also increase. Nevertheless, a large brain and weak muscles in the young are likely to retain their relative size and strength through life. I suggest, therefore, that in the characters mentioned the adult would not differ much from the immature individual described.

The anterior cæcum presents another aspect of the same problem. There is no discernible difference in structure between it and the remaining branches of the gut, and the form corresponds with that in the schematic representation of *Balænanemertes chuni* Bürger given by Brinkmann (1917, p. 157), that is, the shape of a two-pronged fork. *B. chuni*, from Bürger's drawing (1909, taf. vii, fig. 3), has a large median sac in addition to two lateral branches, *i. e.* it corresponds with *B. lobata*, Joubin, in Brinkmann's diagram. According to Brinkmann reduction of the anterior cæcum accompanies reduction in the number and development of the gut branches. This reduction is almost complete in *Pelagonemertes*, where there is a short median sac only. Brinkmann's statement appears to apply to the form under consideration ; but backward growth of the pylorus and forward growth of the two expansions of the gut, which have been described at the point where the pylorus joins it, would result in a form corresponding with *Balænanemertes lata*, Brinkmann, *i. e.* the shape of a four-pronged fork. This does not seem improbable in the course of growth. I cannot feel any confidence, therefore, in the form of the anterior cæcum as a specific character, especially in young animals.

The presence of structures similar to the rudimentary eyes of *Pelagonemertes* suggest relationship with this group, but this is precluded by the absence of lateral nerve muscles.

Bürger described these muscle-strands in *Balænanemertes chuni* collected by the " Valdivia " Expedition. He also described the specimens of *Pelagonemertes* collected, but did not remark the muscle-strands; in fact he states : " Die Seitenstammmuskeln von *Balænanemertes* sind Bildungen, die wir bisher bei keiner anderen Nemertine beobachteten " (p. 207). Brinkmann, however, noted their presence in *Pelagonemertes* and the genera included in the family Pelagonemertidæ. He has also found them in *Pendonemertes*, a genus of the family Bathynemertidæ. They are very evident in my sections of the " Discovery " *Pelagonemertes*, but I can find no trace of them in the specimen described here. I must admit that the small size of the specimen is against certainty on this point. Should the muscle-strands be reduced to the thickness of a single muscle-fibre covered by the outer neurilemma, as Coe has described in *Pelagonemertes joubini* (1926, p. 26), nothing less than perfect fixation and sectioning would have disclosed their presence, and until further material is forthcoming this doubt must remain. On other characters *Nannonemertes* stands in close relation to *Pelagonemertes* and *Armaueria*, and it is to the family Pelagonemertidæ, Moseley, that I refer the genus.

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